COLMAN DOCK TRAFFIC AND QUEUING ANALYSIS

This appendix contains the technical memorandum from Loren Bloomberg, CH2M Hill, titled "Colman Dock Traffic and Queuing Analysis: Assessment of Four-Route Options".

Colman Dock Traffic and Queuing Analysis: Assessment of Four-Route Options

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An update of the Washington State Ferries (WSF) Systems Plan is currently in progress. Among the many options under consideration is a scenario that includes four car ferry routes at Colman Dock. In addition to the existing two routes (Bainbridge and Bremerton), there would be new routes added for Southworth and Vashon Island. With this scenario, the existing service from Fauntleroy would be discontinued (or radically changed).

While four routes would provide additional access from Colman Dock, it would present a series of operational challenges that would need to be addressed. This memorandum outlines those issues (along with summaries of analysis that have been done to address them).

Four key issues arise from a four-route plan:

- Managing exit vehicles will result in operational issues, especially if the number of routes exceeds the number of exits.
- For both entering and exiting vehicles, the additional traffic will degrade operations on City streets.
- The additional demand will increase storage requirements (on and/or off the dock).
- If remote holding is instituted, managing traffic for four routes complicates the system.

Each of these issues is addressed in the sections below.

Exiting Vehicles

With four routes, it will be necessary to offload up to three boats at the same time. This will present challenges as high volumes of unloading vehicles will enter traffic via two signalized intersections on Alaskan Way.

There are two major issues associated with exiting vehicles: merging, and capacity of the signalized intersections. Each is discussed below.

Merging

There are two lanes at each of the two signals at Alaskan. Currently, when two boats arrive simultaneously, operations staff will route offloading vehicles from one boat to the south (Yesler) and the other to the north (Marion). With three boats, vehicles from the middle boat would likely be split to the two intersections. The result would be that the vehicles from the middle boat would need to merge with offloading vehicles. At both intersections (but particularly at Yesler), it will be difficult for the vehicles from the middle boat to merge into the stream of traffic from the other offloading boat. Also, there may be weaving among the vehicles on the middle boat. For example, if the vehicles on the right side of the exit queue from the middle boat want to exit at Marion, they may decide to try to weave over and join the other group of traffic from the middle boat. All of these maneuvers will increase conflicts on the dock, increase the risk for crashes, and degrade customer service.

Capacity

If all three boats arrive at once, and 75% green time is provided for existing vehicles to Alaskan Way, the available capacity matches (exactly) the offload rate. However, this does not account for inefficiencies caused by downstream bottlenecks, or imbalances between the turning lanes available (left or right) and the percentages of turning vehicles. There will likely be localized queuing even with 75% green time available; this underscores the importance of maximizing the available green time for exiting vehicles.

If there is a shortfall (less available capacity for exiting vehicles onto Alaskan Way), it presents operational issues for Colman Dock[1]. Some potential options for dealing with a shortfall are as follows:

- Offload as fast as possible, and store the vehicles on the dock. For example, if the capacity at the Alaskan Way signals was reduced to 48 vehicles/minute, there would need to be storage for approximately 200 vehicles on the dock for intermediate storage upstream of the signals. While this approach would be acceptable in terms of operations on Alaskan Way, it would be costly (in terms of the construction and environmental costs of expanding the dock) and degrade customer service (because offloading vehicles would have to wait before leaving the dock).
- Slow down the offloads from the boats. The exact rate might vary somewhat, but one approach would be to limit the offload rate to 16 vehicles/minute per boat. Once one or two boats were "empty", the offload rate could be increased, As a comparison, with full offload speed (i.e., if only one or two boats are in dock), the offload times are 7 minutes/ Bainbridge, 5.3 minutes/Bremerton, and 4.3 minutes/Vashon. Average offload time for any one vehicle would be 2 to 4 minutes (taking the total offload time and divide by two to get the average). With the reduced offload rate, the offload time would be approximately 12 minutes/Bainbridge, 10 minutes/Bremerton, and 8.1 minutes/Vashon. Therefore, the average offload time would be 4 to 6 minutes. The

[1] To analyze the impacts of exiting vehicles, several assumptions were made. The assumed vessel size by route is Bainbridge (218), Bremerton (160), Vashon (130), and Southworth (130). The worst case would be 218+160+130=508 vehicles all arriving at once. The ferry unload rate used was 30 vehicles/minute per ferry (based on field observations). For Alaskan way exiting, a saturation flow rate of 1800 vehicles/hour/lane of green time was used, with an actual capacity depending on the percentage of green time. Existing conditions are approximately 75% green time, which allows 1800 x 4 x 75%=5400 vehicles/hour or 90 vehicles/minute.

"slow down" approach would increase average offload time by about two minutes. Again, this would present a significant customer service issue.

- Wait to unload one of the boats (say Vashon) until there is capacity at the signals. With this approach, Bainbridge and Bremerton would be offloaded at almost full speed. Then, Vashon would be offloaded, so their offload time would be much higher (about a six minute delay).

The last two options also will result in schedule delays, as the longer unload time will delay the load period, and cause cascading schedule problems throughout the day. Adding a few minutes of offload time per boat could result in the loss of one scheduled boat throughout the day. The first option does not cause this problem, but the increased on-dock storage (for only short periods of time) may not be the best use of the expensive over-water dock space.

Additional Traffic on City Streets

Table 1 summarizes preliminary data for the Systems Plan provided by WSF. The Table lists the predicted PM peak period demand (number of vehicles) for various scenarios. The "Baseline" and Alternatives scenarios are for 2030 traffic.

TABLE 1
Summary of PM Peak Period Demand, by Route

Scenario	Bainbridge	Bremerton	Vashon	Southworth	Notes
Existing	1300	350	--	--	
Baseline	1650	500	--	--	2030 no-action scenario.
Alternative 1	1650	650	--	--	Fewer Bremerton passengers than baseline but more vehicles, due to big increase in passenger-only service to Southworth.
Alternative 2	2250	350	--	650	Bainbridge draws traffic from both Bremerton and Edmonds/Kingston. Southworth route (from Colman Dock) replaces Fauntleroy-Southworth.
Alternative 3	1600	400	700	800	Fauntleroy service is discontinued.
Alternative 4	1350	1050	50	100	Increase in Bremerton traffic includes a shift of traffic from Fauntleroy-Southworth. Increase in traffic to Bremerton Fauntleroy service remains, so limited traffic diverts to Colman Dock.
Alternative 5	1450	950	--	--	Similar to Baseline, but some shift to Bremerton, away from Bainbridge and Fauntleroy-Southworth

Notes

Preliminary data provided by WSF (Celine Gihring), March 8, 2005.

All values rounded to the nearest 50.

In general, the two-route scenarios result in traffic volumes between 2200 and 2400 vehicles (in the PM peak period). The most likely four-route scenario (Alternative 3) has traffic volumes of 3500 vehicles, significantly higher. The actual volumes will depend on the ultimate route structure at other locations (e.g., Fauntleroy) as well as the passenger-only ferries. However, it is clear that a four-route scenario would add significant volumes of traffic to Alaskan Way and other City streets.

Increased Storage Requirements

Each additional route will require additional storage on Colman Dock. During periods of low to moderate demand, all vehicles are stored on Colman Dock. As much as possible, vehicles are stored on the dock, to minimize the impacts to City streets. Current on-dock physical storage is approximately 680 vehicles (the actual number of vehicles stored is somewhat less to provide room for operations). This provides about 1.8 boatload-equivalents of on-dock storage (with an average boat size of 218 for Bainbridge and 155 for Bremerton). To provide a similar ratio (assuming that 160-vehicle boats are used) for a four-route system, storage for approximately 1150 vehicles would be needed on Colman Dock. The actual number required might be higher, because there will be a need for more on-dock storage to minimize queuing external to Colman Dock.

Remote Holding Issues

Remote storage may be an effective operational tool for addressing vehicle storage requirements at Colman Dock. With this approach, those vehicles that cannot be stored on Colman Dock would be stored in a holding area nearby. These vehicles would be released and allowed to enter Colman Dock once sufficient space becomes available. One concept is to use a holding area on Alaskan Way.

The simplest concept for Alaskan Way holding uses two dedicated lanes on the street. One lane would be dedicated for Bainbridge, and another lane would be dedicated for Bremerton traffic. Then, as storage becomes available on Colman Dock for one route or the other, vehicles can be released from the appropriate queue. It is important to control vehicle releases to Colman Dock. In periods of high demand, there may be situations where Colman Dock is overloaded with vehicles for one route (typically Bainbridge), and there may not be enough Bremerton vehicles stored to fill up a boat) even though there are vehicles waiting on the street.

With multiple routes, the situation becomes more complex. One issue is physical – separated storage areas are needed for each route. With an offsite storage area, this is a less critical issue, because space could be allocated dynamically. However, with on-street storage (likely the least expensive option), four routes would require four separate lanes, which is not feasible with on-street holding.

In summary, adding additional routes will increase the need for remote holding, and reduce the options for providing that storage. Larger, more flexible remote holding areas will be needed with four routes.

Conclusions

This memorandum presents several issues associated with a four-route scenario at Colman Dock. This approach would create merging conflicts on Colman Dock, and likely result in queues of offloading vehicles (resulting in degradation of operations, safety, and customer service). It will add traffic to city streets (particularly Alaskan Way), and increase storage needs for Colman Dock and any remote holding areas. All of these issues will result in significant environmental and cost impacts.

Therefore, the four-route structure is not recommended for Colman Dock. While adding two new routes will enhance the access and connectivity of WSF's service, the additional capacity cannot be accommodated by the current configuration and anticipated future improvements at Colman Dock.